Systematic Benchmarking of Monitoring and Diagnosis Systems

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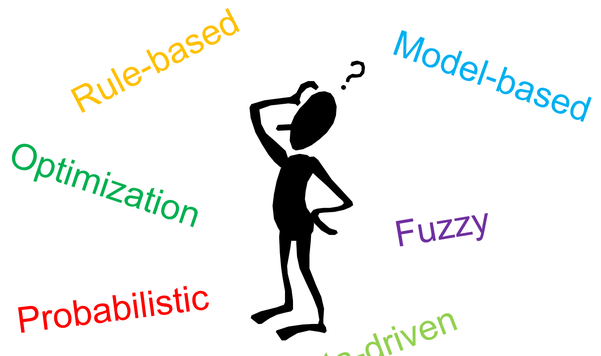
Overview

Motivation

- Wide range of diagnostic algorithms have been developed for aerospace systems to enable autonomous health management
- Lack of comparative analyses for different diagnostic algorithms creates barriers for effective development and deployment
- Difficult to assess the pros and cons of different diagnostic approaches



Objectives

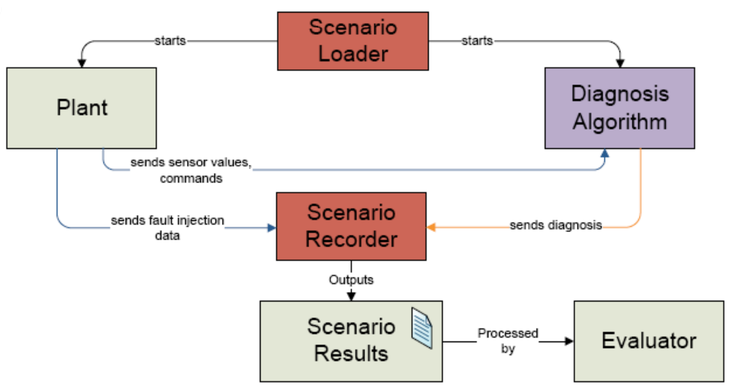
- Develop a formal framework to be used for systematic benchmarking of monitoring and diagnostic systems
- Produce comparable performance assessment results for different monitoring and diagnostic technologies
- Provide an empirical approach that can be utilized by algorithm developers to test and validate their technologies

Benefits

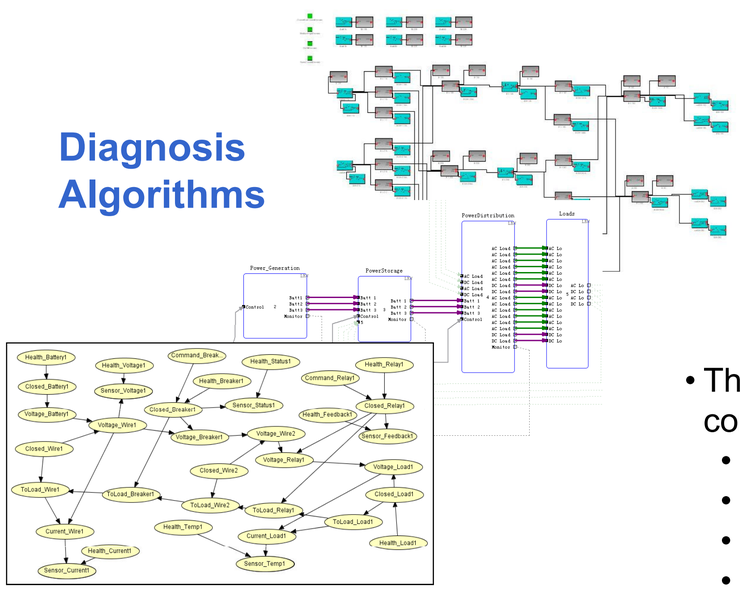
- Generates realistic and standardized datasets to be used for empirical evaluation of monitoring and diagnosis systems
- Provides common vocabularies and ontologies, and well-defined metrics that enables comparative analysis of different diagnostic algorithms and systems
- Encourages the development of software platforms that promise more rapid, accessible, and effective maturation of diagnostic technologies

Methodology

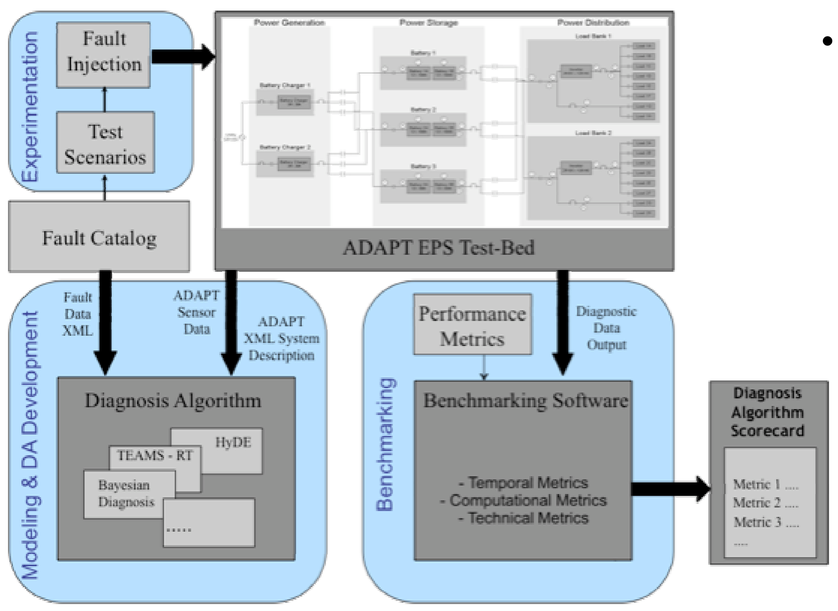
Experimental Protocol



Diagnosis Algorithms



- The benchmarking analysis is performed by means of empirical testing using the Advanced Diagnostics and Prognostics Testbed (ADAPT).



- The framework defines a number of specifications for comparison:
  - Standardized Fault Catalog
  - Metric Definitions
  - Standardized API Architecture
  - Experimental Protocol
  - Metric Calculation Software

ADAPT

- The facility's hardware consists of an electrical power system with components for power generation, storage, and distribution.
- Over a hundred sensors report the status of the system. The test bed provides a controlled environment to inject failures, either through software or hardware, in a repeatable manner.

Metrics

Type	Diagnostic Objectives	Performance Metric
Detect	Time	Time to Detect
	Accuracy	Detection False Positive Rate
	Accuracy	Detection False Negative Rate
	Accuracy	Fault Detection Rate
	Accuracy	Fault Detection Accuracy
	Sensitivity	Detection Sensitivity Factor
	Stability	Detection Stability Factor
Isolate	Response	Time to Isolate
	Computation	Time to Estimate
	Accuracy	Isolation Classification Rate
	Accuracy	Isolation Misclassification Rate
	Resolution	Size of Isolation Set
	Stability	Isolation Stability Factor

Results

Status

- Developed the framework architecture
- Defined the fault catalog, the metrics, the API architecture, and the experimental protocol
- Developed benchmarking software on MATLAB
- Generated preliminary results

METRIC RESULTS	ALGORITHM A
Average Fault Detection Time (sec)	8.977
Average Fault Isolation Time (sec)	11.567
Detection False Positive Rate	0.000
Detection False Negative Rate	0.000
Fault Detection Accuracy	1.000
Isolation Classification Rate	0.972

Diagnostic Competition

- Diagnostic Competition (DXC-09, June)
  - http://www.dx-competition.org/
- Industrial Track Using ADAPT
- Synthetic Track Using ISCAS-85

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